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INTERNATIONAL APPLICATION NO.:	INTERNATIONAL FILING DATE:	PRIORITY DATE CLAIMED:
PCT/FR99/02066	30 AUGUST 1999	31 AUGUST 1998

TITLE OF INVENTION: USE OF SELENIUM FOR TREATING PATIENTS SUFFERING FROM SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS), AND COMPOSITION FOR IMPLEMENTING THE TREATMENT

APPLICANT(S) FOR DO/EO/US: Xavier FORCEVILLE and Dominique VITOUX

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [X] has been transmitted by the International Bureau. (see attached copy of PCT/IB/308)
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [X] A translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Item 11. to 16. below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A **FIRST** preliminary amendment.
    [ ] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [X] Other items or information:

International Search Report
PCT/IPEA/409
PCT/IB/308
Application Data Sheet
Abstract of the Disclosure on a Separate Sheet

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/763870	INTERNATIONAL APPLICATION NO. PCT/FR99/02066	ATTORNEY'S DOCKET NO. 569J US 3770

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

Neither international preliminary examination fee (37 CFR1.482) nor international search fee (37 CFR1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO . . . . . $ 1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO . . . . . $ 860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . . $ 710.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) . . . . . $ 690.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) . . . . . $ 100.00

	CALCULATIONS PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00
Surcharge of $130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492(e)).	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$
Total claims	22 - 20 =	2	X $18.00	$ 36.00
Independent claims	3 - 3 =	0	X $80.00	$
MULTIPLE DEPENDENT CLAIMS(S) (if applicable)			+ $270.00	$

TOTAL OF ABOVE CALCULATIONS =	$ 896.00
Reduction of ½ for filing by small entity, if applicable. Applicant claims Small Entity Status under 37 CFR 1.27. +	$ 448.00
SUBTOTAL =	$ 448.00
Processing fee of $130 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR1.49(f)).	$
TOTAL NATIONAL FEE =	$ 448.00
Fee for recording the enclosed assignment (37 CFR1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property+	$ 40.00
TOTAL FEES ENCLOSED =	$ 488.00
	Amount to be refunded:
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a. [X] A check in the amount of $ **488.00** to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. **25-0120** in the amount of $ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required by 37 CFR 1.16 and 1.17, or credit any overpayment to Deposit Account No. **25-0120**. A duplicate copy of this sheet is enclosed.

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February 28, 2001

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PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Xavier FORCEVILLE et al.

Serial No. (unknown)

Filed herewith

USE OF SELENIUM FOR TREATING PATIENTS SUFFERING FROM SYSTEMIC INFLAMMATORY SYNDROME (SIRS), AND COMPOSITION FOR IMPLEMENTING THE TREATMENT

PRELIMINARY AMENDMENT

Commissioner for Patents

Washington, D.C. 20231

Sir:

Prior to the first Official Action and calculation of the filing fee, please substitute Claims 1-22 as originally filed, with Claims 1-22 as filed in the Article 34 amendment of September 21, 2000. The pages containing Claims 1-22 are marked "AMENDED SHEET" and are attached hereto. Following the insertion of Claims 1-22, please amend these claims as follows:

IN THE CLAIMS:

Claim 3, line 1, change "one of claims 1 or 2," to --claim 1,--.

Claim 4, line 1, change "one of claims 1 or 2," to --claim 1,--.

Claim 5, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 6, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 7, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 8, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 9, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 11, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 12, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 15, line 1, change "any one of the preceding claims," to --claim 1,--.

Claim 20, line 1, change "any one of claims 16 to 19," to --claim 16,--.

Claim 21, line 1, change "any one of claims 16 to 20," to --claim 16,--.

Claim 22, line 1, change "any one of claims 16 to 21," to --claim 16,--.

R E M A R K S

The above changes in the claims merely place this national phase application in the same condition as it was during Chapter II of the international phase, with the multiple dependencies being removed. Following entry of this

amendment by substitution of the pages, only claims 1-22 remain pending in this application.

Respectfully submitted,

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February 28, 2001

Use of selenium for treating patients suffering from systemic inflammatory response syndrome (SIRS), and composition for implementing the treatment

The present invention relates to the use of selenium for treating patients suffering from systemic inflammatory response syndrome (SIRS).

It also relates to a composition for implementing this treatment.

The role of selenium, as an oligo-element involved in many reactions in the organism, is widely known.

Thus, this element plays a major role in the intracellular antioxidant system, particularly as a component of glutathione peroxidase. In addition, selenium appears to play a direct role in the regulation of the inflammatory process.

Since the 1970's, selenium deficiency has been linked with severe cardiomyopathies, found in particular in populations living in regions of China which are deficient in selenium. The effectiveness of sodium selenite in oral form, both as a prophylactic and as a cure, against these diseases has been described.

The role of selenium in intense oxidative stress situations has been shown.

VITOUX et al. (1966, Therapeutic Uses of trace elements, Neve et al. ed., Plenum Press, New York, 127-131) have shown that the plasma concentration of selenium decreased significantly in patients admitted to intensive care units presenting a systemic inflammatory response syndrome.

However, no information was given as to the use of selenium to treat such patients.

ZIMMERMANN et al. (1997, Medizinische Klinik, 92, 3-4 suppl. III) have described, but not in detail, the results of a study on the effect of sodium selenite in patients suffering from systemic inflammatory response syndrome. In this study, the patients first received an injection of 1000 µg of sodium selenite, then 1000 µg of sodium selenite per day by continuous perfusion for twenty-eight days. The authors considered the administered dose of selenium to be optimal.

However no information was given as to the pathology of the patients treated. It is simply stated that these were patients suffering from SIRS, of which some had organ failures of unspecified nature. In addition,

ZIMMERMANN et al. mentioned that the control group had a mortality rate of 40%, which is a high figure considering the type of patient treated and the stated severity index. These figures thus have low credibility and, in addition, do not agree with other data given in this article. It is thus not possible to deduce from this article what pathologies might be treated by selenium.

GARTNER et al. (Med. Klinik., 1997, vol. 92, Suppl. 3, pp. 12-14) describe the results of a clinical study in which patients suffering from systemic inflammatory response syndrome had received, in comparison with controls, an additional dose of 500 µg, 250 µg and 125 µg respectively of sodium selenite, at a frequency of one dose per day for 3 days.

BORNER et al. (Med. Klinik., 1997, vol. 92, Suppl. 3, pp. 17-19) describe a clinical study of 34 children aged from 1 to 16 years, suffering from surgical inflammatory diseases, such as extensive burns. The exogenous application of selenium was performed at a dose of 200 µg pf selenium pentahydrate for patients weighing less than 15 kg, of about 500 µg for patients with weights of between 15 and 30 kg and of about 1000 µg for patients weighing more than 30 kg.

The low doses of selenium administered to the patients included in the clinical studies described by ZIMMERMANN, GARTNER and BORNER were justified by the many prejudices existing against the use of higher doses, which were generally accepted to be toxic and to present risks for the patient's life.

The PCT application n° WO 96/30007 concerns the use of mercapto and seleno derivatives as inhibitors of the enzyme nitric oxide synthase or NO synthase. This document only discloses the in vitro inhibition activity of this enzyme; such results cannot be extrapolated by a person skilled in the art in order to predict the in vivo activity of such compounds, and especially not the doses at which these compounds would be active in vivo.

Other studies describing the effect of selenium on various pathologies have been published. Thus the article of YA-JUN HU et al. (1997, Biological Trace Element Research, 56, 331-341) describes the use of selenium to reduce the toxicity of an anti-cancer product, cisplatine, in cancer patients. The patients were treated with doses of 4 mg per day of selenium, in the form of kappa-selenocarrageenan, orally.

Some of these studies show results which are conflicting and obtained on unconvincing experimental bases.

Thus, the skilled person was faced with a large number of documents

stating that selenium could be used in various pathologies, but without having any real certainty as to the effect of this oligo-element, considered as toxic and pro-oxidant in the dosage regimes used in some oxidative stress situations.

Moreover some pathologies revealing a systemic inflammatory response syndrome (SIRS) are responsible for significant mortality rates, mainly in intensive care units, and severe visceral failure potentially requiring major life-support therapy.

It is thus necessary to develop a treatment which can reduce this mortality and reduce the incidence of associated visceral failures.

However, patients presenting a syndrome of the SIRS type are in a very weakened state, following an oxidative stress situation, and are considered to be poorly able to resist doses of selenium thought to be toxic, and additionally themselves pro-oxidant.

It is thus not possible for a person skilled in the art to extrapolate results obtained from patients with other pathologies to patients presenting a syndrome of the SIRS type, and to use doses of selenium considered as toxic and pro-oxidant in an oxidative stress situation.

The present invention has shown that it is possible to reduce the mortality and the incidence of visceral failures, particularly renal, respiratory, haematological (coagulation), cardiovascular, hepatic, gastro-intestinal and neurological failures resulting from a systemic inflammatory response syndrome (SIRS) by using high doses of selenium in comparison with those generally considered to be toxic by a skilled person.

It has thus been shown that good effectiveness is obtained in the treatment of syndromes of the SIRS type by treating the patients with a drug containing during the first days of the treatment a high dose of selenium, then by reducing this dose in the subsequent treatment.

The object of the present invention is thus the use of at least one molecule containing selenium, in a quantity corresponding to a daily dose of about 2 to 80 mg, and preferably 4 to 40 mg of atomic selenium equivalent, for the production of a drug for treating severe systemic inflammatory response syndrome (SIRS), or any state corresponding to a severe acute attack of an inflammatory pathology causing an exacerbation of cytokine secretion. Particularly included in this definition are any severe acute infectious condition, whether the infection is of bacterial, fungal, viral or parasitic origin.

A dose of 2 to 80 mg of atomic selenium equivalent corresponds to a

dose of 0.025 to 1 mg/kg, which is the range of preferred dose in man or animals. The administration of such doses involves a strict clinical follow-up.

According to the present invention, systemic inflammatory response syndrome, or SIRS, should be understood as any pathology fulfilling the definition given by BONE et al. in 1992 during the ACCP/SCCM standardisation conference (BONE et al., 1992, Chest, 101, 1644-1655).

The invention is applicable in human and veterinary medicine.

In general, the drug administered during the initial phase of the treatment, preferably the first or the first four days of the treatment, comprises a quantity of the molecule containing selenium able drastically to reduce the inflammatory state of the patient during this initial phase of the treatment. During this period particularly, the drug is adapted to the administration of a quantity of the molecule or molecules containing selenium which is sufficient to maintain the inflammatory state of the patient or animal below a certain threshold. Thus, the quantities of the molecule or molecules containing selenium administered daily may be adapted to the particular inflammatory situation of each patient, since the level of the inflammatory response may be verified for each patient throughout the treatment.

For example, the level of the inflammatory state may be evaluated by quantifying the different cytokines in the plasma, preferably IL-6 which is currently considered as the most reliable indicator of the extent of an inflammatory situation, but also TNF-α or IL-1.

The quantity of interleukin-6 present in the serum or the plasma is preferably evaluated, for example, by a test of the ELISA type such as that distributed by MEDGENIX (Belgium).

The daily dose of the molecule or molecules containing selenium will be adapted so as to maintain the circulating level of interleukin-6 at least 30%, advantageously at least 40%, and most preferably at least 50% lower than the quantity of interleukin-6 evaluated just before the treatment by a pharmaceutical composition according to the invention. These values are given as an indication and may vary according to the pathology and, for an animal, according to the species, as a function of the clinical results obtained with the modulation of the inflammatory reaction. For monitoring the interleukin-6 levels in patients with an acute inflammatory reaction, the person skilled in the art may advantageously refer to the article by REINHART K. et al. (1996, Crit. Care Med. Vol. 24, n° 5, pages 733-742).

For quantifying the circulating levels of TNF-α, a person skilled in the art may refer to the ELISA test described by ENGELBERTS I. et al. (1991, Lancet, Vol. 338, pages 515-516).

The quantification of serum or plasma IL-1 may be performed according to the technique described by MUNOZ C. et al. (1991, Eur. J. Immunol., vol 21, pages 2177-2184).

The level of the oxidative stress state of a patient may also be evaluated by the TBA-RS test.

Finally, the level of the substances reactive to oxygen (ROS) also represents a good indicator of the inflammatory state of the patient, and may be measured for example according to the technique described by FUKUYAMA N. (1997, vol. 22 (5), pages 771-774).

This is a test for measuring the concentrations of the substances reacting with thiobarbituric acid (TBARS), present in high concentration, for example greater than 4 µ/mol/litre in patients in an acute inflammatory situation, this value being given as an indication.

To perform the measurement of the concentration of TBARS, a skilled person may advantageously refer to the article by GOODE H.F. et al. (1995, Critical Care Medicine, vol. 28, n°4, pages 646-651).

The level of peroxynitrites may be estimated by determination of nitrotyrosine, see "Quantification of protein-band 3-nitrotyrosine and 3,4-dihydroxyphenylalanine by high-performance liquid chromatography with electrochemical array detection" (HENSLEY K. Analytical Biochemistry 251, pages 187-195, 1997).

The level of the inflammatory state of the patient may also be evaluated by measuring the state of resistance of the polymorphonuclear cells to apoptosis, which is a proposed marker of the pro-inflammatory activation of these polymorphonuclear cells.

To perform this measurement, a skilled person may advantageously refer to the technique described by MARTIN S.J. et al. (1996, Cell, vol. 82, pages 349-352).

Monitoring the inflammatory situation of the patient during the treatment by a pharmaceutical composition according to the invention may also be performed by measuring the state of activation of the oxidative metabolism of the polynuclear neutrophils, such as the measurement by chemiluminescence as described for example by ALLEN R.C. et al. (1986, Meth. Enzymol., vol. 133,

pages 449-493).

The drug corresponding to a daily dose of 2 to 80 mg, and preferably 4 to 40 mg, of atomic selenium equivalent, is preferably administered over a short time period, at the beginning of the treatment, with the subsequent treatment using lower doses of selenium.

The object of the present invention is therefore the use of at least one molecule containing selenium for treating SIRS in a quantity corresponding to a daily dose of about 2 to 80 mg of atomic selenium equivalent, at the beginning of the treatment, then a daily dose of about 0.5 to 2 mg of atomic selenium equivalent, in the subsequent treatment.

According to another embodiment, during the initial treatment period, increasing or decreasing doses, modulated according to the inflammatory reaction, of the molecule or molecules containing selenium may be administered so as to maintain the inflammatory state of the patient or the animal below a given level, and at a given level, which may be verified by one of the techniques described above. The molecule or molecules containing selenium may thus be administered at daily doses which may be varied and modulated during the day as a function of the monitoring of the inflammatory reaction and the oxidative stress, ranging from 2 to 80 mg of atomic selenium equivalent, i.e. from 0.025 mg/kg to 1 mg/kg of atomic selenium equivalent.

Such a drug is preferably intended for the treatment of septic shock states such as peritonitis, pneumopathies, meningitis or bacterial septicemias and, more generally, any severe acute infectious state endangering the life of the patient, whether the infection be of bacterial, fungal, viral or parasitic origin.

It is also intended in general for the treatment of patients having a severe immuno-inflammatory reaction, associated with pancreatitis, extensive burns, multiple trauma, any type of septicemia, especially bacterial, but also in the context of severe parasitic, fungal or viral states, a major surgical operation, a surgical operation with clamping (ischemia-reperfusion), a state of shock whatever its etiology or type. The new drug may also be used in patients presenting a visceral failure. The patient may also be suffering from an alcoholic hepatopathy, cirrhosis, of whatever origin, anorexia, undernourishment, malnutrition, or AIDS or a chronic inflammatory pathology, especially intestinal.

According to a preferred embodiment, the drug is produced so as to give a daily dose of about 2 to 80 mg, preferably 4 to 40 mg, of atomic selenium

equivalent, during the first day, and optionally the second, third and fourth days of treatment.

It is also advantageously produced so as to give a daily dose of about 0.5 to 2 mg of atomic selenium equivalent for 1 to 20 days and, preferably, from 1 to 10 days during the subsequent treatment, i.e. 0.025 to 1 mg/kg and, preferably, 0.05 to 0.5 mg/kg.

The molecule containing selenium may be any pharmacologically acceptable molecule. It may be a selenium salt, such as a selenite or selenate of inorganic selenium, or an organic selenium, for example selenocysteine, selenomethionine, selenodiglutathione, selenomethyl selenocysteine, dimethyl selenoxide, selenocystamine, selenated yeasts or synthetic chemicals containing one or more atoms of selenium. It is preferably sodium selenite.

It is possible, and even sometimes advantageous, to combine different forms of selenium during the use of selenium such as proposed by the invention, in particular during the phase when the very high doses are administered (from 0.025 or 0.05 to 1 mg/kg).

Sodium selenite is the preferred form but other forms of selenium may be used in combination, such as selenocysteine, selenoglutathione or other selenium compounds.

The use of a mixture of several selenium compounds may allow more specific modulation of such aspect of the reaction of the organism during a severe SIRS by thus taking advantage of the effect of a selenium compound present in the mixture on the specific aspect to be treated: oxidative stress, NO synthesis, activation of NFKB and other transcriptional factors, secretion of pro- and anti-inflammatory cytokines, adhesins, activation of different cascades (arachidonic acid, coagulation, complement, etc.), activation of the polymorphonuclear cells and other phagocytic cells, initial resistance to apoptosis of these phagocytic cells, endothelial apoptosis and secondary visceral tissue. For example, although sodium selenite seems in general the most appropriate, for the control of certain components of the systemic inflammatory reaction such as, particularly, to modulate the action on apoptosis, it is possible to combine it with other selenium compounds.

Without wishing to be bound by any particular theory, the applicant is of the opinion that the selenium acts on target sites such as the glutathione peroxidase and selenoprotein P (vessel walls), so as drastically to reduce, at the daily quantities of atomic selenium equivalent according to the invention,

the adverse effects and the level of Reactive Oxygen Species (ROS), and thus the consequences, of an oxidative stress and excessive oxidative stress for the patient or animal. The applicant also considers that the selenium causes a modulation of the concentration of intracellular peroxides, notably by its action on glutathione peroxidase, inducing a limitation of the activation of some transcription factors, and especially NFKB, which could lead to a reduction of the production of NO synthase and certain cytokines such as IL-6.

In addition, the applicant considers, without wishing to be bound by such a theory, that selenium at very high doses induces a significant apoptosis of some cells involved in the inflammatory response of the host, particularly the polynuclear neutrophils or by modification of their cell cycle. These actions on these cells are likely considerably to reduce the inflammatory state of the patient or animal, at least at the high daily doses of atomic selenium equivalent recommended. In contrast, at more moderate doses, although still high compared to the doses currently considered as usable, particularly in an oxidative stress situation, the selenium could reduce the harmful apoptosis of severe inflammatory states (endothelial cells, visceral tissue cells), in particular by the reduction in extra- and intracellular oxidative stress which it causes.

Also, when selenium compounds are used in accordance with the invention, they could exercise, when administered at very high doses, a direct antibacterial (bactericidal), antiparasitic, antiviral or antifungal action.

In consequence, a drug according to the invention advantageously contains, in combination with a therapeutically effective quantity of the molecule or molecules containing selenium, a therapeutically effective quantity of at least one compound able to inhibit oxidative metabolism or to reduce the inflammatory reaction.

The invention thus has the further object of the use of at least one molecule of selenium such as defined above, in combination with an effective quantity of at least one non-selenium compound inhibiting oxidative metabolism or acting against the consequences of oxidative stress or inhibiting the inflammatory reaction.

Various compounds inhibiting oxidative metabolism or strengthening the defences of the organism against oxidative stress may be used, in a drug according to the invention, in combination with at least one molecule containing selenium.

According to a first embodiment, a drug according to the invention

comprises, in combination with the molecule or molecules containing selenium, vitamin E, optionally combined with vitamin C, taking part in the protection of membranes against oxidative stress, a precursor of glutathione, known in the state of the art, such as N-acetylcysteine, the glutathione regenerating the glutathione peroxidase in its reduced form.

According to a second embodiment, the drug contains an iron chelator, such as desferioxamine, able to reduce the production of peroxides. Desferioxamine is advantageously present in the drug for a daily dose of between 5 and 100 mg/kg. The drug may also contain a copper chelator, to exercise the same effect.

According to a third embodiment, a drug according to the invention contains, in combination with the molecule or molecules containing selenium, a therapeutically effective quantity of zinc or copper.

According to a fourth embodiment, the copper chelator and the copper are separately included in the drug, for delayed release over time. A combination of the molecule or molecules containing selenium with a copper chelator is advantageously used at the beginning of the treatment, then a combination of the molecule or molecules containing selenium with copper is used for the subsequent treatment.

Such a drug may comprise, in addition to the molecule or molecules containing selenium, vitamin E, vitamin C or zinc, or any other molecule with antioxidant activity, and which is pharmacologically compatible with the molecule containing selenium. The addition of these vitamins or this metal potentiates the effect of the selenium.

As an indication, a drug, or a pharmaceutical composition, may contain a quantity of vitamin E optionally combined with vitamin C at a daily dose of between 20 and 2000 mg of each vitamin.

A drug or a pharmaceutical composition according to the invention may additionally contain zinc at a daily dose of between 5 and 50 mg, or any other essential oligo-element.

The drug advantageously contains copper at a daily dose of between 1 and 10 mg/kg.

The drug advantageously contains N-acetylcysteine at a daily dose of between 50 and 500 mg/kg/d.

The drug preferably contains an inflammatory reaction inhibitor, for example gold at a daily dose of between 25 and 300 mg/kg.

In the case of renal insufficiency, the administration of a urinary elimination chelator, such as desferioxamine, is preferably combined with extra-renal purification by continuous hemodiafiltration or by extended hemodialysis.

According to a fifth embodiment, a drug according to the invention comprises several compounds selected from compounds which are inhibitors of oxidative metabolism and compounds reducing or inhibiting the inflammatory reaction.

The drug is preferably prepared in an injectable or perfusable pharmaceutical form or for enteral administration. It may however be in any form which allows the administration of the molecule or molecules containing selenium and the effective treatment of the SIRS.

This drug may be administered by the parenteral route, preferably by intravenous, also by subcutaneous, intramuscular, and also by intraperitoneal, enteral or oral routes.

This drug is preferably intended as curative. It may however be administered preventatively, particularly before a major surgical operation, especially vascular surgery, so as to limit the oxidative stress.

Such a drug or pharmaceutical composition may contain pharmaceutically acceptable excipients, in addition to the molecule or molecules containing selenium. In the form of a perfusion, it may contain between about 1.3 mg/l and 800 mg/l of atomic selenium equivalent.

The present invention is illustrated, without in any way being limited, by the following examples.

EXAMPLE 1

A patient aged 51, 75 kg, chronic alcoholic with no history of icteroascitic, hemorrhagic or encephalopathic compensation, was admitted to postoperative intensive care with generalized purulent peritonitis from colonic perforation during an attack of diverticular sigmoiditis.

His initial hemodynamics were maintained by perfusion. He was intubated-ventilated under sedation with a FiO_2, slightly increased, of 50%. There was a moderate renal insufficiency. An adapted empirical antibiotic therapy was begun, and modified after 48 hours in view of the antiobiograms. At 24 hours his severity indexes were IGS II 29, APACHE II 17 and SOFA score was 5. One day after the operation, the situation worsened rapidly with onset of a state of shock with lactic acidosis 5 µmol/l requiring administration of dopamine then rapidly noradrenaline up to 4 mg/h (0.9 µg/kg/min). There was

a deterioration of his respiratory state requiring increase of the FiO_2 because of the onset of an acute adult respiratory distress syndrome (ARDS). As soon as the necessity of noradrenaline administration was recognized, a treatment with sodium selenite by continuous administration was begun at a dose of 4 mg of atomic selenium equivalent over the first 24 hours, followed by continuous administration of sodium selenite at a dose of 1 mg of atomic selenium equivalent for 10 days.

This treatment had the effect of limiting the extent of this vasoplegic shock condition, thus avoiding early death. This treatment also resulted in limiting the extent of visceral failure. The progress was marked by the outcome of a renal insufficiency with continued diuresis, but not requiring dialysis. Ventilation at FiO_2 70% was very transiently necessary because of a rapidly resolved ARDS. The administration of noradrenaline was progressively withdrawn in three days. The lactic acidosis regressed rapidly. There was no appearance of disseminated intravascular coagulation, the platelet level remaining higher than 150 000 platelets/mm^3. No postoperative nosocomial infection was observed, and in particular no nosocomial pneumopathy. Nor was there any abdominal complication. This patient left intensive care 10 days after the operation.

He returned for a consultation 3 months afterwards. He then recommenced his working career and his normal lifestyle.

EXAMPLE 2

A female patient aged 35, depressive, anorexic, 51 kg and 1.75 m tall, was admitted on a tentative diagnosis of drug-induced suicide with ingestion of a large amount of analgesics and sedatives. The diagnosis was rapidly changed to generalized purulent peritonitis from a perforated gastric ulcer. She was transferred to postoperative intensive care. There was also a shock condition requiring perfusion and introduction of catechol amines as noradrenaline and dolbutamine; lactic acidosis at 6 µmol/l. Antibacterial and antifungal antibiotic therapy was performed. Diuresis was maintained under diuretics. One hour after the start of noradrenaline administration, a treatment with sodium selenite by continuous administration was begun at a dose of 4 mg of atomic selenium equivalent over the first 24 hours, followed by continuous administration of sodium selenite at a dose of 1 mg of atomic selenium equivalent for 10 days. At 24 hours the severity indexes were IGS II 44, APACHE II 35. The SOFA score was 8.

Progress was initially favourable with regression of the shock condition in 24 hours. There were no significant visceral failures, return of diuresis (creatinine clearance at 40), ventilation FiO_2 60%, no PEP (positive expiration pressure), no coagulation problems except a platelet level of 50%. Onset of two atelectasia attacks requiring fibroaspiration. Early enteral feeding was installed.

Eight days after the operation, there was a persistence of a purulent discharge in the drains. Abdominal scanning showed a sub-hepatic gathering, without free peritoneal effusion. A puncture under scanner was performed to drain this gathering. Bacteriological tests on the free pus revealed colonies of Hafnia alvei and Candida albicans; the antibiotic therapy was modified according to the antibiogram.

Twelve days after the operation, a nosocomial pneumopathy from hemolytic alpha Streptococcus arose (diagnosed by fibroscopy with a protected telescopic brush and brochoalveolar washing). An empirical antibiotic therapy against gram positive cocci was installed, then adapted to the antibiogram. Extubation was performed 20 days after the operation. Extensive physiotherapy was necessary to avoid reintubation.

This patient was transferred to convalescent care for continuance of renutrition on the 35th day. She returned for consultation after 3 months. Her weight had risen to 56 kg. Psychotherapy was begun.

EXAMPLE 3

A patient aged 57, presenting major alcohol-tobacco addiction (more than 1 litre of wine per day, 2 packets of cigarettes per day), chronic BPCO respiratory insufficiency, stage 2 arteritis of the lower limbs and deterioration in general health for several months with a productive cough, was transferred to intensive care after a short stay in general medicine. At admission there was a respiratory distress requiring emergency intubation-ventilation. Blood gases confirmed major respiratory acidosis. The patient was feverish. There was a hyperleucocytosis of 24 000 leucocytes of which 88% were polymorphonuclear cells. Blood pressure was stable under perfusion, however there were blotches on the knees. There were no coagulation problems nor renal insufficiency. At 24 hours IGS II was 41, APACHE II 26, and SOFA score 8. Lung samples taken by protected telescopic brush and brochoalveolar washing confirmed the diagnosis of community-acquired pneumonia: 47% of cells infected, Haemophilus influenza β-lactamase negative and wild-type streptococcal

anginosis. Dual antibiotic therapy was started which should prove effective against these organisms. Thoraco-abdominal scanning showed a large liquid gathering within the pulmonary parenchyma of the right lower lobe, appearing to fistulize in the pleural with pleurisy. The abdominal scan also revealed the existence of a thrombosed aneurism of the sub-renal abdominal aorta.

The immediate development was marked by a rapid deterioration of his respiratory state with necessity of ventilation at FiO_2 100%, PEP 8. In addition, very substantial perfusion was necessary with measurement of pressure by right catheterization. Dopamine had to be administered at 10 µg/kg/min. After 8 hours dopamine administration, a treatment with sodium selenite by continuous administration was begun at a dose of 4 mg of atomic selenium equivalent over the first 24 hours, followed by continuous administration of sodium selenite at a dose of 1 mg of atomic selenium equivalent for 10 days.

After increase of the dopamine to 20 µg/kg/min and addition of adrenaline at 1 mg/h, the hemodynamics seemed to stabilize. The hyperlactatemia increased in parallel up to 10 µmol/l, then reduced as from the second day. Progress towards a fatal shock condition was thus avoided. At the respiratory level, treatment with nitrogen monoxide (NO) was started at 10 ppm. Diuresis was maintained under diuretics. There was a thrombopenia at 7500 platelets/mm^3 combined with a lengthening of the coagulation time and an increase in fibrin degradation products, indicating a moderate CIVD. Drainage of the purulent pleurisy was instituted.

As from the second day a progressive improvement of the situation was observed, both respiratory and hemodynamic. The drainage allowed complete evacuation of the pleurisy with drainage of the pulmonary abscess. The catechol amines were withdrawn on the fifth day. Extubation was performed on the sixth day. The patient was transferred back to pneumology on the fifteenth day for continuing exploration and treatment of his respiratory insufficiency.

This patient was seen in consultation 3 months afterwards. A dental abscess was treated. A return to normal work is under way. The patient does not have oxygenation at home.

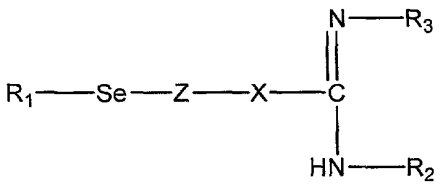
These results are in agreement with those obtained over a larger series, showing a clear improvement of the prognosis of patients treated with high doses of selenium compared with those having received a placebo.

By IGS II should be understood the simplified severity index II defined by LE GALL et al. in 1993 (A New Simplified Acute Physiology Score) [SAPS II]

Based on a European/North American Multicenter Study, JAMA, 1993; 270:2957-2963), by APACHE II (Acute Physiology and Chronic Health Evaluation II) the severity index defined by W.A. KNAUS et al. (APACHE II: A severity of disease classification system. Crit. Care Med. 1985; 13: 818-829), and by SOFA score, the score of visceral failure defined by J.L. VINCENT et al. (The SOFA [Sepsis-related Organ Failure Assessment] score to describe organ dysfunction/failure. Intensive Care Med. 1995; 22:707-710).

CLAIMS

1. Use of at least one molecule containing selenium, in a quantity corresponding to a daily dose of about 2 to 80 mg of atomic selenium equivalent, i.e about 0.025 to 1 mg/kg, for the production of a drug for treating severe systemic inflammatory response syndrome or any state corresponding to a severe acute attack of an inflammatory pathology causing an exacerbation of cytokine secretion, with the exception of a molecule of formula



in which :

R_1 is H, alkyl, alkenyl, phenyl, alkylene, alkenylene or phenylalkylene or a substituted derivative of these;

when R_1 is alkylene or alkenylene, R_1 may be bonded to the amidino group, to Z or to X to form a heterocyclic ring with 5, 6 or 7 members, provided that when R_1 is bonded to the Z group, Z is an alkylene or an alkenylene or a substituted derivative of these, and, when R_1 is bonded to the X group, the X group represents CR_5 or N;

R_2 and R_3 are independently H, lower alkyl, alkenyl, alkylene, alkenylene, amino, phenyl or phenylalkylene, or a substituted derivative of these;

when R_2 is alkylene or alkenylene, R_2 may optionally be bonded to the imino N group located adjacent to the carbon atom of the amidino group to form a heterocyclic ring with 5 or 6 members;

Z represents an alkylene, alkenylene, cycloalkylene or cycloalkenylene group or a substituted derivative of these;

when R_2 or R_3 represents an alkylene or alkenylene, R_2 or R_3 may optionally be bonded to the adjacent Z group to form a heterocyclic ring with 5 or 6 members containing nitrogen and carbon atoms and additionally not more than one oxygen or sulfur atom provided that this heterocyclic group is optionally substituted by a lower alkyl, alkoxy, halo, hydroxy or amino group;

X represents N, NR_4, O, CR_5 or CR_4R_5;

R_4 represents H or an alkyl, thioalkylene or thioesteralkylene group;

R_5 represents H or an alkyl, alkylene, alkenylene, thioalkylene,

that the associated non-selenium compound is selected from vitamin E and optionally vitamin C, a glutathione precursor, an iron chelator, a copper chelator, copper, or zinc.

19. Pharmaceutical composition according to claim 17, characterized in that the compound inhibiting the inflammatory reaction is gold.

20. Composition according to any one of claims 16 to 19, characterized in that it contains an essential oligo-element other than selenium or those cited above (Cu, Zn).

21. Composition according to any one of claims 16 to 20, characterized in that it is in an injectable or perfusable form or for parenteral administration, preferably intravenous (also subcutaneous or intramuscular), but also intraperitoneal, enteral or oral.

22. Composition according to any one of claims 16 to 21, characterized in that it is in the form of a perfusion containing between about 1.3 and 800 mg of atomic selenium equivalent per litre.

Ref. 5695 US

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

the specification of which: *(check one)*

REGULAR OR DESIGN APPLICATION

[ ] is attached hereto.

[ ] was filed on _____ as application Serial No. _____ and was amended on _____ (if applicable).

PCT FILED APPLICATION ENTERING NATIONAL STAGE

[x] was described and claimed in International application No. PCT/FR99/02066 filed on the 30th August 1999 and as amended on 20th September 2000 (if any).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

PRIORITY CLAIM

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

Country	Application Number	Date of Filing (day, month, year)	Priority Claimed
France	98 10889	31st August 1998	Yes

(Complete this part only if this is a continuing application.)

I hereby claim the benefit under 35 USC 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37 Code of Federal Regulations §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.) (Filing Date) (Status--patented, pending, abandoned)

TSVP

POWER OF ATTORNEY

The undersigned hereby authorizes the U.S. attorney or agent named herein to accept and follow instructions from ____ _____ as to any action to be taken in the Patent and Trademark Office regarding this application without direct communication between the U.S. attorney or agent and the undersigned. In the event of a change in the persons from whom instructions may be taken, the U.S. attorney or agent named herein will be so notified by the undersigned.

As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: **Robert J. PATCH, Reg. No. 17,355, Andrew J. PATCH, Reg. No. 32,925, Robert F. HARGEST, Reg. No. 25,590, Benoît CASTEL, Reg. No. 35,041, Eric JENSEN, Reg. No. 37,855, and Thomas W. PERKINS, Reg. No. 33,027,** c/o YOUNG & THOMPSON, Second Floor, 745 South 23rd Street, Arlington, Virginia 22202.

Address all telephone calls to Young & Thompson at 703/521-2297.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Full name of third joint inventor, if any:
(given name, family name)

Inventor's signature _____ Date _____

Residence: Citizenship:

Post Office Address: